Ontario
Ministry of
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Communications

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ROAD SURFACE RECYCLING HEATER SCARIFIER TEST SECTION HWY 59 LONDON DISTRICT

MATERIALS INFORMATION
ENGINEERING MATERIALS OFFICE

ONTARIO
MINISTRY OF TRANSPORTATION AND COMMUNICATIONS

ROAD SURFACE RECYCLING HEATER SCARIFIER

TEST SECTION, HWY. 59, LONDON DISTRICT

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Materials Information Report No. 73

TABLE OF CONTENTS

		PAGE
I	INTRODUCTION	1
II	HEATER SCARIFICATION (PAST)	1
III	RSR HEATER SCARIFIER (EXISTING)	2
IV	HWY. 59 DEMONSTRATION SECTION	7
V	TESTING	8
VI	OBSERVATIONS	11
VII	TEST RESULTS	12
VIII	DISCUSSION	15
IX	COMMENTARY ON RSR MACHINERY	16
X	RSR PROPOSED FINAL MACHINE	17
XI	PERFORMANCE EVALUATION AFTER 2 WINTERS	19
XII	RECOMMENDATIONS/CONCLUSIONS	21

APPENDIX 1 - SPECIFICATIONS OF HEATER SCARIFIER 5000

APPENDIX 2 - ENVIRONMENTAL CONSIDERATIONS

(I) Introduction

A demonstration section of surface recycling by heater scarifier was installed by the Ministry of Transportation and Communications (MTC) on Contract 84-06, Hwy. 59 from Langton southerly, London District. The heater scarifier used was a prototype machine which can heat, scarify and re-screed an existing hot mix surface. The heater scarifier is owned by Road Surface Recycling (RSR) of Markham, Ontario.

To date MTC has undertaken very little heater scarification. A proposal from RSR was made to the New Products Committee (MTC) on 84-02-21 outlining the concept of a single piece of equipment capable of combining the operations of heater scarifying, recycling and addition of new hot mix. RSR speculated that this system would provide a viable alternative to conventional recycling with milling, exhibit similar performance characteristics and provide for significant cost savings. It was apparent that MTC generally lacked sufficient documented knowledge to assess the capability of the existing heater scarifier and the proposed equipment. Given this, a field trial was undertaken to provide this data. A demonstration in Metro Toronto was observed prior to installation of MTC test section.

Included in this report is the following:

(i) description of the existing machine

(ii) test/monitoring methodologies on the demonstration section

(iii) test results to date

(iv) commentary on the existing machinery

(v) description of currently proposed final machine

(vi) conclusions/recommendations.

(II) Heater Scarification (Past)

The heater scarifier concept is not new. Early heater scarification systems used an open flame to heat the asphalt prior to scarification. Scarification took the form of blading (with a mounted grader blade) or with tines. The heater scarified material was generally windrowed and picked up for recycling or disposal.

Problems with the early systems were:

(i) environmental - open flame burning adjacent vegetation
- smoke from operation

(ii) existing asphalt cement was oxidized by overheating

(iii) insufficient depth of heat penetration prior to scarification resulting in a planing operation

Second generation heater scarifiers (planers) used radiant heat in the operation. The radiant heater addressed the open flame problems and provided for more uniform heat control. However, to get sufficient heat penetration the rate of production was slow in comparison to available cold planing equipment.

(III) RSR Heater Scarifier (Existing)

The Road Surface Recycling heater scarifier (Heater Scarifier 5000) was constructed by Benedetti Manufacturing Company of Cleveland, Ohio. This heater scarifier system is mounted on a grader frame. For specifications of the Heater Scarifier 5000 refer to Appendix 1.

At the very front of the grader frame, a pre-heater (0.86 m x 3.61 m) is mounted (Figure 1). There are three propane powered furnaces which direct heat to the enclosed pre-heater. The adjacent rubber tires are cooled by sprays of water.

The primary heater box (3.49 m x 3.61 m) is located between the front and rear tires where the mouldboard is usually located (Figure 2). The heater box is fibre fax insulated and contains twelve individual propane fueled furnaces. Air and hot gases are combined in a combustion chamber. A hydraulic blower circulates the heated gases under the heater box. RSR claims that the temperature under the heater box can be controlled from 40 to 800°C.

The fuel source for the heater scarifier, as indicated previously, is propane which is stored in two 1800 L pressurized tanks located over the tandem wheels of the grader frame. The liquid propane is vaporized (via a liquid vaporizer) to provide complete combustion, thereby achieving higher temperatures.

The heated asphalt surface is scarified by two rows of rakes or tines (Figure 3 & 4). The depth of scarification is controlled manually by the use of the hydraulic controls. The rakes are located behind the tandem wheels of the grader frame.

FIGURE 1: FRONT VIEW HEATER SCARIFIER 5000

FIGURE 2: PRIMARY HEATER

FIGURE 3: SCARIFYING RAKES (ELEVATED)
(Note original position of rejuvenator spray bar)

FIGURE 4: SCARIFYING RAKES IN OPERATION

Mounted behind the rakes, by means of hydraulic arms pivoting at the end of the grader frame, is a conventional auger and vibratory screed system from a paver (Figure 5). The screed which is 2.4 m wide has a 600 mm plate and hydraulic extensions (strike off). The auger system redistributes the scarified material along its length (Figure 6). Additional material (new hot mix) to correct for rutting and other surface distortion is dumped in front of the auger by a "bobcat" loader. The loader works on the hot mat behind the screed (Figure 7).

The existing machinery has not been specifically designed to accommodate the application of asphalt rejuvenator during the heater scarifying process. For the MTC demonstration, attempts were made to provide a spray system between the rakes and auger. Problems were encountered and will be addressed in more detail in the next section.

FIGURE 5: SCREED ATTACHMENT

FIGURE 6: AUGER SYSTEM & REJUVENATOR SPRAY BAR

FIGURE 7: BOBCAT LOADER ADDING NEW HOT MIX

(IV) Hwy. 59 Demonstration Section

This was the first large scale heater scarification application undertaken by the MTC. The purpose of the Hwy. 59 demonstration section was:

(i) to demonstrate/monitor the RSR heater scarifier in operation,
(ii) determine the effects of heater scarification on the penetration of residual asphalt cement,
(iii) observe the addition of rejuvenator to the recycled surface course,
(iv) determine if the heater scarifier could correct for crossfall and slight rutting and improve the ride characteristic of the roadway,
(v) determine if heater scarification aids in the prevention of crack reflection through the overlay (i.e. heat seal the cracks).

On August 14 and 15, 1984, the demonstration section was installed on Contract 84-06, Hwy 59. The demonstration section covered both lanes from Sta.14+615 to Sta.16+615 (Langton south limits). Located midway through the demonstration section is the intersection of Regional Road 1 (Sta.15+615).

It had originally been intended to cold plane this section and overlay with 40 mm of RHM. However the southern portions of the project had insufficient depth of asphalt to carry the traffic after cold planing. The pavement, particularly the outside 600 mm on both sides, was breaking up. Subsequently cold planing was deleted from this portion of the contract. The proposal to install a heater scarification test section was agreed to by the Regional Construction Office.

South of Regional Road 1 (Sta.14+615 to 15+615) the existing pavement was heater scarified and rescreeded with some new hot mix added to correct for rutting. No rejuvenator was added.

North of Regional Road 1 to the Langton south limits (Sta.15+615 to 16+615) the existing pavement was heater scarified, new hot mix added to correct for rutting and rejuvenator generally applied throughout. There were two small areas where rejuvenator was not added (Sta.15+615 to 15+625 NBL and Sta.15+641 to 15+760 NBL). The rejuvenator was Reflux, an emulsified rejuvenating agent manufactured and distributed by Norjohn Limited of Niagara Falls.

The application of rejuvenator was attempted by spraying from Sta.15+625 to 15+641. Problems were encountered with the spraying nozzles during the operation because apparently an asphalt emulsion had contaminated the

rejuvenator, causing the nozzles to plug. An emulsion had previously been hauled in the tank truck which brought the rejuvenator to the site and the tank had not been sufficiently cleaned. The emulsion was suspended in the form of small droplets throughout the rejuvenator.

The rejuvenator was added for the balance of the section north of Regional Road 1 with a "drip bar". Originally the drip bar was located between the rakes and the auger. However, the rejuvenator was not being sufficiently mixed and distributed by the auger and was appearing at the surface behind the screed as "streaks". The drip bar was then moved in front of the rakes. The mixing of the rejuvenator was marginally better but still the rejuvenator was in "streaks". After the completion of the heater scarifier demonstration the contractor, RSR, deemed that these streaks of rejuvenator were unacceptable (Figures 8 & 9). On his own initiative he reworked these sections with the heater scarifier and eliminated the streaks.

For the 2 km test section (two lanes) some 60 t of HL-3 was added by the bobcat loader to correct for rutting. During the operation of the heater scarifier, compaction was attained with a steel break down roller followed by a rubber tired roller. About one month after installation the entire contract, including the heater scarification test section, was tack coated with SS-1 and overlaid with 40 mm of RHM.

A detailed summary of the field operations is provided in a report prepared by Trow Consulting Engineers, who were engaged by RSR (2).

(V) Testing

The Ministry provided the following data collection:

(i) To determine if 'heat sealing' of the cracks occurred, two 150 m sections were crack mapped. One section Sta.14+850 to 15+000 was inside the area to be heater scarified with no rejuvenator. The other was a control section (Sta.13+550 to 13+700) outside the heater scarified test area. Both sections were overlaid with 40 mm RHM. Pavement cores were taken in both areas prior to heater scarification to determine the penetration of the recovered asphalt cement.

(ii) A Mays meter survey was undertaken from Regional Road #45 northerly to Langton (Sta.12+798 to 16+615) to determine original riding quality. This extended outside the heater scarifier test section.

FIGURE 8: STREAKS CAUSED BY POOR MIXING OF REJUVENATOR

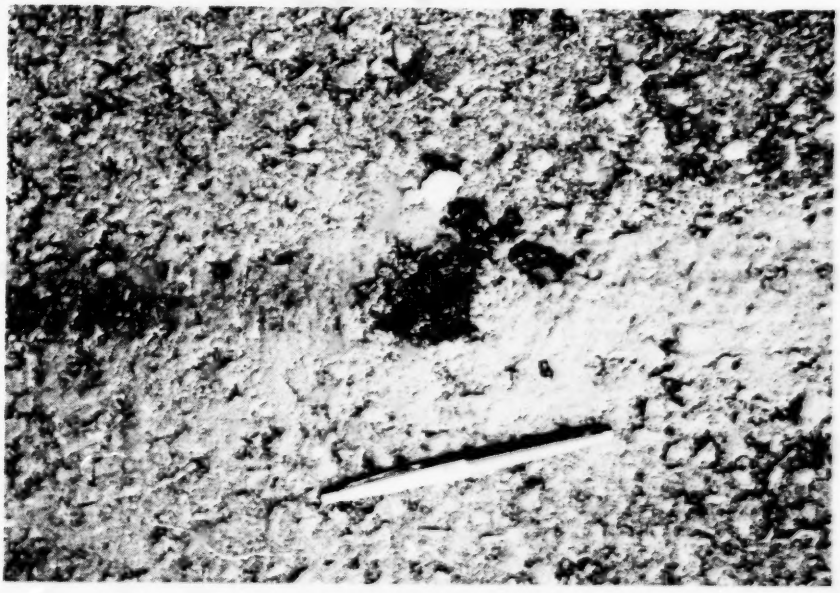


FIGURE 9: REJUVENATOR STREAK

(iii) Road samples were taken from between the primary heater and the rakes. The penetration of the recovered asphalt was determined from these samples. This would identify the effects of heater scarification without the addition of conventional hot mix or rejuvenator.

(iv) Road samples were taken behind the paver screed where rejuvenator and conventional hot mix were added. Road samples were also taken when the areas of rejuvenator which had streaked were reworked. The penetration of the recovered asphalt was determined from these samples.

Road sampling consisted of scooping up, with a shovel, sufficient heated material to carry out all the testing.

Trow Consulting Engineers (2) provided laboratory and field work for RSR to determine the following:

1) characterization of existing surface course mix by testing for gradation, asphalt content and penetration of the recovered asphalt cement on the upper 25 to 30 mm of slab samples taken from the original pavement. In addition, Marshall testing including density, stability and flow, air voids and voids in mineral aggregate (VMA) was undertaken.

2) concentration of rejuvenating agent required.

3) evaluation of pavement surface condition by means of a mechanical profiler which provides transverse and longitudinal profile measurements at nine random sections, each 15.2 m long. Profiling was done on the original surface after heater scarification and following construction on the overlay.

4) characterization of scarified road mix by testing for gradation, asphalt content and penetration of the recovered asphalt cement on road samples taken behind the heater scarifier with rejuvenator added. Marshall testing was also completed on the road samples.

(VI) Observations

The general operation of the machine was good. The 2 km demonstration section (two lanes) was completed in two days. The resulting texture was generally quite open (Figure 12) and resulted in a knobby or stoney appearance. This texture is consistent with heater scarified surfaces. The nature of the heater scarifying operation is such that the coarser aggregate is brought to the surface.

There were some additional textural deficiencies with respect to MTC Form 310 which included segregation, tire marks from the bobcat loader and poor joint overlap which would make it unacceptable as a final surface. A narrow screed with hydraulic strike-off was used and this generally would not be acceptable.

In the section where the rejuvenator was added, the texture was marginally tighter when compared to the sections where no rejuvenator was added. After traffic had been on the section, with rejuvenator, for about a month there was a slight amount of sealing in the wheel tracks (midlane was not sealed). This action would be consistent with the higher asphalt cement content and higher residual penetration of the asphalt cement. The reworking of the material a second time may have helped marginally.

There were two small ravelled/delaminated areas in the section without rejuvenator. This could have been caused by delamination at the interface between the binder and the thin lift left by the heater scarification (similar to cold planing).

There was a perceived improvement in the ride (without Mays meter survey data) regarding crossfall and wheel rutting on the heater scarified surface, although the knobby texture of the mix did detract from the riding quality. The Trow profile data confirms that wheel rutting was removed. Only marginal crossfall correction was confirmed by the profile data.

During operation of the heater scarifier there was little or no "blue smoke" being produced. There was some blue smoke when a section where rejuvenator was heated and scarified. The overall process has been endorsed by the Environmental Office of the Ministry of Transportation and Communications. (See Appendix 2).

(VII) Test Results

The test results from both the Ministry and the consultant are detailed in TABLE 1. Original penetration was in the order of 22 to 24 and it was apparent that heater scarification did not significantly affect the penetration of the residual asphalt cement. However penetrations of such low order generally would require a large amount of heat to be affected. The rejuvenator did increase the penetration of the recovered asphalt in heater scarified material. The large variations in the penetrations of the recovered asphalt reflect the inconsistency in the distribution of the rejuvenator. The high penetration (171 to 175) was sampled from the flushed streaks. The lower penetrations (32 to 42) was sampled from the areas between the drip plumes. When the rejuvenator section was reheated, it appeared that the penetration was lowered and this is consistent with the consultant's report that, "it was recommended that excess asphalt be deliberately "burnt off" by reheating and scarifying, and this was done" (2).

TABLE 1: TEST RESULTS

	ORIGINAL	AFTER HEATER SCARIFICATION (no rej.,no conv.H.M.)	AFTER HEATER SCARIFICATION (with rejuv.)	AFTER REHEATING REJUV. SECTIONS
Penetration				
TROW	24	-	42 to 175	32
MTC	PEN_{ave}=22.5	PEN_{ave}=23.8	32 to 171 PEN_{ave}=75.4	42
Viscosity @ 135°C (mm 2/s)				
MTC	$VISC_{ave}$=992	$VISC_{ave}$=1059	$VISC_{ave}$=511	594

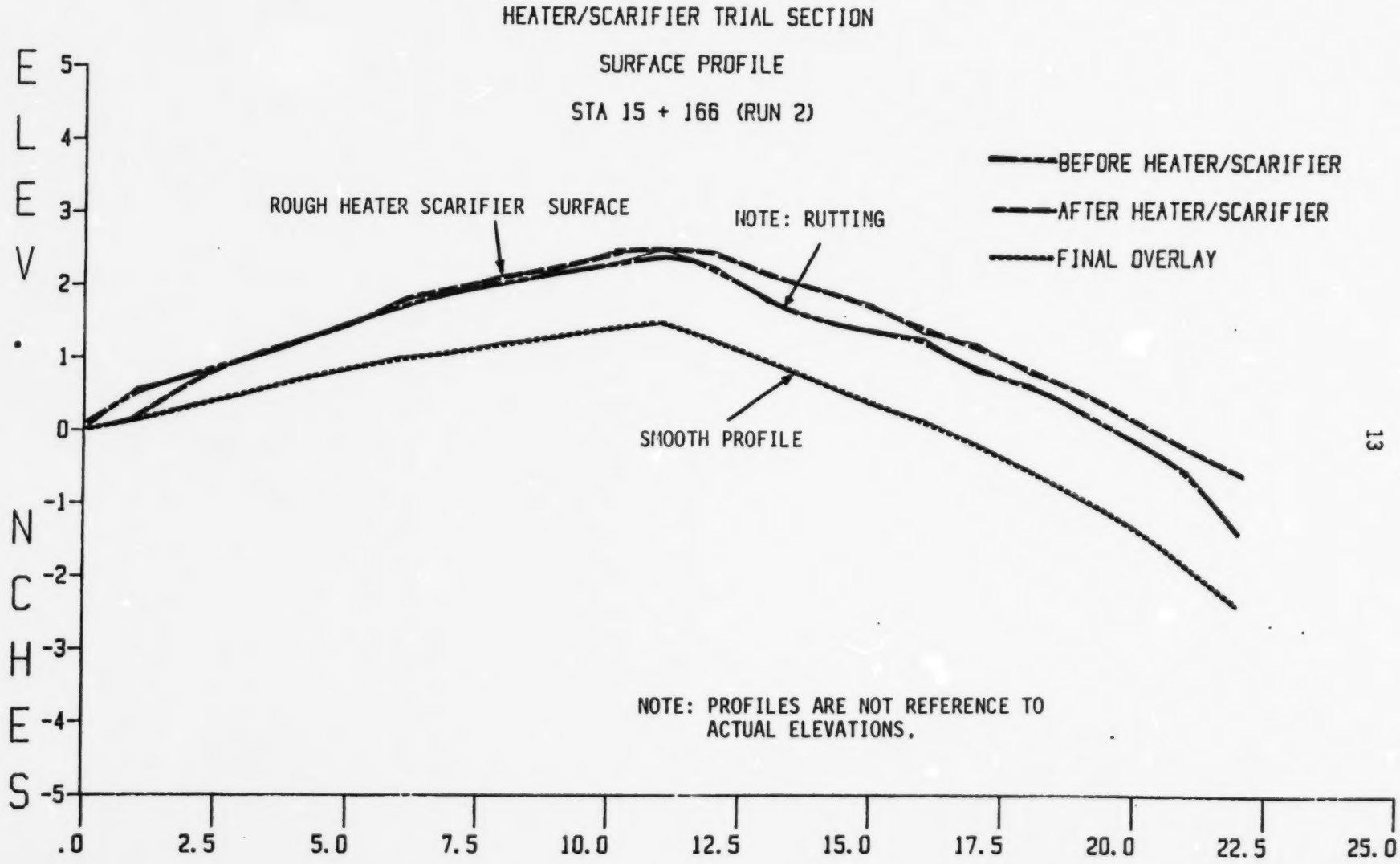


FIGURE 11: TYPICAL CROSS-SECTION PROFILE (AFTER TROW (2))

FIGURE 12: TYPICAL OPEN TEXTURE ASSOCIATED WITH HEATER SCARIFICATION

The testing undertaken by Trow indicates the following:

i) Areas of high dosage of rejuvenator indicate higher percentages of asphalt cement in the extractions.

ii) The rejuvenator appears to affect the Marshall properties of the mix by increasing flow, reducing air voids and VMA and reducing stability (stability still high and exceeding minimum required).

iii) The in-situ air voids are quite variable ranging from 4.8 to 7.6% for the rejuvenated areas and 6.1 to 8.3% for the original pavement. It appears that the rejuvenated areas have somewhat lower air voids. No in-situ air voids were undertaken on areas without rejuvenator.

iv) The surface cross-section profiles indicated that the final overlay was very smooth.

The original pavement cross-sections indicated some wheel track rutting. The heater scarified surface indicated at best only marginal crossfall correction but elimination of the wheel track ruts. The rough texture associated with the heater scarifier surface was also highlighted in the cross-section profile. Figure 11 indicates a typical cross-section profile. It is felt that the Dipstick Profiler used by Trow may be too sensitive for asphalt profiling.

The data from the crack survey and the Mays meter survey will be retained and evaluated by the Bituminous Section for future comparison.

(VIII) Discussion

Based on the test data, the following is apparent:

1) Heater scarification did not reduce the penetration of the original asphalt. However, the original penetration was 22 to 24, which represents an aged pavement. With a residual penetration of that order it would have required a large amount of heating to significantly lower the penetration. If the residual penetration had been higher the heater scarifying may have reduced the penetration. This was evidenced in the reheating of the section where rejuvenator had been added.

2) With the application of Reflux, an emulsified rejuvenating agent, the penetration of the mix was increased. Serious problems with plugging of the spray nozzles occurred. The drip system which replaced the spray system was totally unacceptable and resulted in streaks of flushed material.

3) The profile of the road was improved by heater scarification. Wheel ruts were removed and some crossfall correction was achieved.

4) Road performance vis-a-vis crack reflection, and roughness (Mays meter), will be monitored and evaluated by the Bituminous Section, MTC.

5) The open textured surface left after heater scarification by the Heater Scarifier 5000 is typical of any heater scarified surface. The nature of the heater scarifying operation is such that coarse aggregate that is embedded at or below the surface is brought to the surface. Given the relatively shallow depth of heat penetration, the coarse aggregate does not become re-embedded in the matrix (as it would after compaction of the original mat). Many agencies recognize that the open textured mix associated with heater scarifiers should not be used as a surface course.

The mat deficiencies could be caused by:

- the conventional HL3 mix added in front of the screed may have been "stoney", causing some open texture.

- the roughness in the ride by floating of a very light screed when excess material got in front of it.

- insufficient heating depth did not permit embedment of the coarse aggregate upon compaction.

- the narrow screed with strike-off extensions caused some segregation and poor centreline joint overlap.

Discussions with Regional Quality Assurance staff indicate that the mat texture would be accepted recognizing it would be overlaid. The heater scarified surface was left open to traffic for a month with no significant problems.

(IX) Commentary on RSR Machinery

The existing prototype machinery can heat the surface course to a depth of 20 mm. The heated material can be scarified, re-distributed, re-screeded and compacted.

The heating system is generally adequate for the operation. An increase in the depth of heat penetration would permit better compaction and allow for a greater depth of scarification. Currently, only slight to moderate distortions (less than 10 mm) (crossfall and rutting) can be removed. The depth of heat penetration and the redistribution system (i.e. the paver augers) restricts the Heater Scarifier 5000 from fully addressing greater distortions. The addition of conventional hot mix aids in the redistribution of material. To correct for moderate to severe distortions significantly more hot mix would be required.

From work elsewhere (i.e. Metro Toronto) it was observed that the rake system does not work well around manholes and catch basins. When an obstruction is encountered, the rake system is hydraulically raised above the obstruction and the heater planer proceeds. The rake system is then lowered beyond the obstruction. The material beside the obstruction for the balance of the lane width is not treated.

The paver screed at the rear of the Heater Scarifier 5000 is too narrow (uses hydraulic strike-offs) for most roadwork and is too light. When conventional hot mix was added in front of the screed it had a tendency to "float". The addition of material by the loader does not provide for uniform distribution of material in front of the screed. The method of addition of conventional mix with the bobcat loader, working off the hot mat, is unacceptable. The loader tires leave marks in the surface.

RSR has not demonstrated an effective method of applying rejuvenator. Given that the addition of rejuvenator has been successfully accomplished elsewhere by other firms, usually by tanker with spray bar behind the heater scarifier, this problem should not be insurmountable.

(X) RSR Proposed Final Machine

The new integral heater scarifier proposed by Road Surface Recycling is expected to address the deficiencies detailed above. The proposed machine would alleviate the problems by:

1) an improved heater system to obtain deeper heat penetration allowing for better compaction and crossfall correction.
2) front loading hopper with internal conveyors eliminating the bobcat loader working off the hot mat.
3) twin screeds that would provide an overlay directly on the heated and scarified surface, allowing for potentially thinner overlays and no exposure of the open textured mat.
4) Proper sized screeds (width and weight).

5) Rakes on spring plates to "float" over manholes while the balance of the road width would be scarified.

6) A pressurized spray system for the application of rejuvenator.

The proposed machine is detailed in "Proposal by RSR" (draft copy) (1). The unit will be self propelled on six wheels, each driven by a hydraulic motor. The components of the machine are to be:

1) Receiving Hopper

A hopper from a paver will be located at the front of the machine to receive conventional hot mix.

2) Heating System

The heating system will consist of a high temperature fan and burner. Gases will be heated by a burner using either propane, oil or heavy oil. The heated gases will be circulated by the fan to the heater box. Cooled gases will be returned for reheating. RSR predicts supply gas temperatures of 650°C. To avoid flashing of the asphalt surface, RSR anticipates that their state-of-the-art burner will provide 100% combustion (i.e. all oxygen will be burned off).

The heater box will be mounted under the main frame between front and rear tires. The heater box will be adjustable in width from 2.5 to 5 m and will be 7 m long. The insulated heater box will incorporate a hot gas jet delivering system with baffles for even distribution throughout the box. Cooled gases will return to the burner via a plenum around the perimeter of the heater box. High velocity turbulence is anticipated at the asphalt surface providing a more effective heat transfer and greater heat penetration.

3) Raking System

The raking system will consist of four rows of carbide tipped rake teeth spaced 25 mm apart and offset by 10 mm, row to row. The rakes will be attached to spring plates to allow the teeth to float over obstructions (manholes etc.) giving uninterrupted operations and full width scarification. The raking system will be extendable from 2.5 to 5 m. Hydraulic pressure will be applied to the raking system to maintain even penetration and level contact with the surface.

4) Rejuvenator Spray System

The application of rejuvenator will occur via a pressurized spray bar located between rows 2 and 3 of the raking system. The spray system will be monitored/controlled to adjust rates of application to speed of travel.

5) Primary Screed

The primary screed (strike-off plate) will be located about 1 m behind the raking system. The screed will be automatically extendable to 5 m. To provide for compaction the screed will be vibratory. Two 200 mm diameter augers which are reversible will be located in front of the screed. The augers will provide for even distribution of material and mixing of the scarified material with a controlled quantity of new conventional hot mix. The primary screed will be connected to automatic grade controls.

6) Secondary Screed

The secondary screed will be located about 1 m behind the primary screed. The secondary screed is to be used to place new material as a surface wearing course. This screed will be a vibratory "Extendomat" extending up to 5 m in width. The secondary screed will perform much the same as the primary screed. The augers will be 350 mm diameter to distribute the larger quantities of asphalt.

7) Drag Conveyors

Drag conveyors will transport new material (conventional hot mix) from the receiving hopper through the machine to front of the secondary screed. Over the auger in front of the primary screed, a chute with gates will provide for the addition of new material. The gates will control the delivery of new material to the primary screed. At the end of the main drag conveyors, two veil augers will distribute material left and right. This should create an even veil of new material in front of the secondary screed.

(XI) PERFORMANCE EVALUATION AFTER 2 YEARS

On 86-03-25, a survey of the heater scarifier test and control sections on Hwy. 59 (Cont. 84-06) was undertaken for the purpose of an evaluation after two winters.

Heater Scarifier Test Section (Sta. 14+850 to 15+000)

- NBL has several intermittent sections of very slight pavement edge cracking within 50 mm of E.P., Sta. 14+850 to 14+925, also occasional small section (up to 5 m) of very slight pavement edge cracking 150 mm inside E.P.

- Sta. 14+925 to 14+960 NBL has intermittent sections of slight pavement edge cracking extending up to 150 mm inside E.P.

- No distress in SBL.

- Several small popouts in RHM surface caused by contamination (rubber, wood, etc.) but are not a function of heater scarifier test section.

Control Section (Sta. 13+550 to 15+700)

- NBL exhibits very slight edge cracking 150 mm inside E.P. from Sta. 13+550 to 13+575 and again at Sta. 13+615 to 13+635.

- From Sta. 13+675 to 13+700 there is very slight to slight pavement edge cracking 150 mm inside E.P.

- No distress in SBL.

Note: From Regional Road 45 northerly to Langton the NBL is exhibiting pavement edge cracking and SBL has little/no distress. It appears there has been some shoulder heaving (probably due to core construction) throughout the heater scarifier test area. This has provided for slight to medium edge cracking (some multiple) up to 300 mm inside E.P. in the test area.

Observation

There is no discernable difference between the heater scarifier monitoring section and the control section after two winters.

Detailed crack mapping is not required at this time. At the time crack mapping is to be done, a survey crew should lay out sections (there are monuments within test section limits).

(XII) Recommendations/Conclusions

1) The concept of heater scarification has merit. Certain agencies/municipalities use heater scarification for surface recycling to supplement or in lieu of the milling/recycling option.

2) Heater scarification would be suited to an urban setting with curb and gutter (providing blue smoke emissions are below the acceptable level) or in intermediate depth (75 to 100 mm) pavements which require some crossfall correction, but may be too thin for cold planing.

3) The existing RSR heater scarifier has demonstrated the ability to heat, scarify, re-distribute and compact the upper portion (20 mm) of a surface course. Some profiling was accomplished. There were several deficiencies identified in the existing operation. These included unacceptable method of addition of new hot mix, no proven method for rejuvenator application, and light screed with strike off extensions.

4) Heater scarification recycling can be considered as an alternative to present rehabilitation methods if and when suitable equipment is available in Ontario and has demonstrated acceptable results.

5) The existing test section should be monitored and a final report prepared.

6) 1985 tenderings for large contracts in the Montreal area (700,000 to 1,000,000 sq. m) indicate heater scarifier prices of from $1.25 to $ 1.58 per sq. m.

References

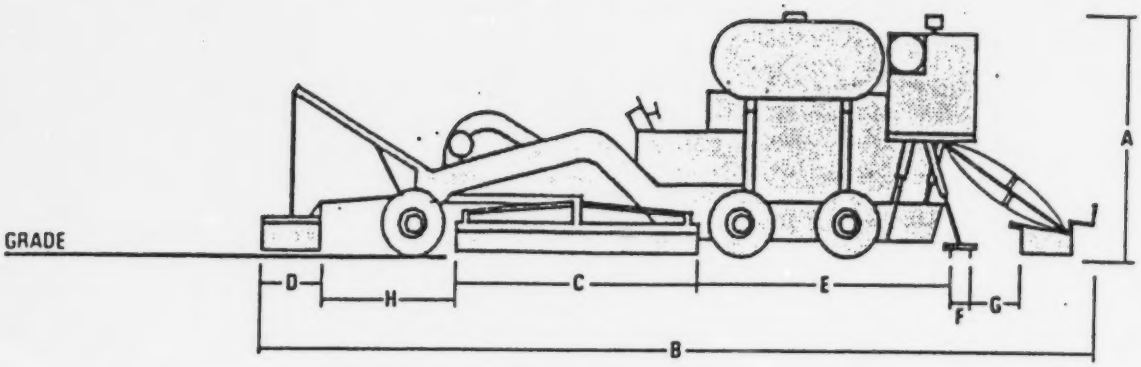
1) Road Surface Recycling "Proposal by RSR" (draft copy) Nov. 1984.

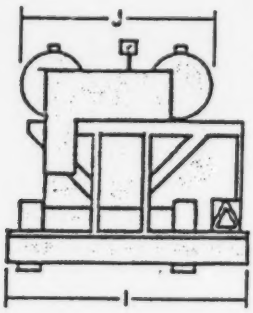
2) Trow Consultants Ltd. "Heater/Scarifier Trial Section Hwy.59, South of Langton, Ontario" Project T4859-ATS Nov. 1984.

Appendix 1

Specifications for Heater Scarifier 5000.

HEATER SCARIFIER 5000





	IMPERIAL SYSTEM	METRIC SYSTEM
DIMENSIONS:		
A. Overall Height of Tractor	10'-4"	3.15 m
B. Overall Length	38'-7"	11.76 m
C. Heater Box Length	11'-5"	3.49m
D. Preheater Width	2'-10"	0.86m
E. Rear Heater to First Rake	13'-0"	3.96m
F. Spacing Between Rakes	0'-11"	0.28m
G. Back of Rake to Screed	8'-0"	2.44m
H. Distance Between Preheater and Mainheater	8'-0"	2.44m
I. Working Overall Width	11'-10"	3.61m
J. Shipping Width	9'-8"	2.95m

	IMPERIAL SYSTEM	METRIC SYSTEM
WEIGHT:		
Overall Weight of Tractor	46,000 lbs.	20,865 kg
OPERATIONAL DATA:		
1. Operating Range	12-24 FPM	3.66-7.32m/min.
2. Travel Speed	0-24 MPH	0-38.6 km/h
3. Depth of Penetration	1"-1½"	2.5-3.8cm
4. Water Tank Capacity	90 GAL	409 l
5. Fuel Tank Capacity	50 GAL	227 l
6. Hydraulic Tank Capacity	80 GAL	364 l
7. Propane Capacity	800 GAL	3,637 l
8. No. of Rakes	130	
9. Minimum Side Clearance to Curb	3"	7.6cm

SPECIFICATIONS

RSR Road Surface Recycling
15 Croxley Green, Markham, Ontario L3R 3T5 (416) 292-6149

Appendix 2

Environmental Considerations

memorandum

Ontario

To: To File

Date: 1984 09 05

RE: Asphalt Heater-Scarifier for Pavement Rehabilitation

On August 14, 1984 I travelled to the junction of Highway 59 and Haldimand-Norfolk County Road 21 south of Langton to view the operation of the above equipment. This memo documents my observations.

The equipment is basically a pavement heater using flames fueled by propane and contained within a shroud at the front of the machine. The softened asphalt is then scarified by sharpened tines at the back of the machine. The resulting heated and now loosened asphalt is then smoothed and compacted by steel rollers. Virgin asphalt is added prior to compaction where needed.

The operation produces practically no smoke and very little odour except for a short time when the equipment is first starting up. The product is an open graded asphalt which gives a slightly bumpy ride.

I asked about the incidence of smoke being generated when plastic sealing material was encountered. The contractor informed me that initially he encountered some problems but learned by accident that the application of a pyrene-based fire extinguisher on such patches prior to the passage of the heater scarifier stopped the production of the smoke.

The contractor on this job planned to use the heater-scarifier as an alternative to milling the pavement and recyling the used asphalt into a 50:50 recycled mix. Rather, he was prepared to recycle the existing pavement using the heater-scarifier and then resurface with 100% virgin asphalt. He felt that this was cheaper because

1) he had the heater-scarifier equipment,

2) he would not have to triple handle the old asphalt (mill, pick-up and transport and then re-transport),

3) there were less stringent environmental requirements to meet re control of blue smoke.

In conclusion, I was quite impressed with the process, and provided this equipment, or newer equipment, could produce the required pavement rehabilitation with the same level of environmental contamination, I felt that the process was more desirable than the alternative which involved milling, transporting, processing and re-transporting.

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BITUMINOUS SECTION

It is my opinion that this process would be acceptable to all regulatory bodies and I do not expect any unfavourable comments.

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